Experimental Investigation of the Heat Transfer in a Room using Night-Time Cooling by Mixing Ventilation

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For many years focus has been on reducing the energy need for heating in buildings. This has lead to buildings with low energy demands for heating but often at the expense of the need for cooling of the building. In order to design buildings with low or zero energy need energy efficient strategies for cooling buildings are required. One such strategy is the combination of thermal mass and night-time ventilation where the excess energy during daytime is store in the building construction and removed by night-time ventilation.
This paper addresses the efficiency of night-time ventilation by the use of full-scale measurements. The efficiency of night-time ventilation depends on the outdoor temperature and the heat transfer between the room air and the building constructions. In a full-scale test room the heat transfer was investigated during 12 hour of discharging by night-time ventilation. Three different air change rates and three different temperature differences between the inlet air and the room temperature resulting in nine different cases where conducted. For all cases the convective and radiation energy exchange was calculated fore all the room surfaces.
The ceiling was subdivided into 22 areas and the convective heat transfer coefficient ranged between 5 and 30 W/m^2. The ratio of convective to total heat flow from the ceiling depends on the air change rate, ranging from approximately 40% at the low air change rates to approximately 70% at the high air change rate. Even though radiation account for a large part of the energy transfer from the ceiling the results from this investigation compared to previous investigations showed that the total energy exchange from the ceiling was only slightly affected by changing the emissivity of the floor.

Keywords:
Night-time ventilation, emissivity, mixing ventilation, convective heat transfer.

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